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=> set hig off SET COMMAND COMPLETED
L1 4585 AIRBAG/Q
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L2 41 CERRIC (W) AMMONIUM (W) NITRATE OR CE (1W) NH (2W) NO
L3 0 L1 AND L2
L4 0 L2 AND AUTOIGNITION
L5 381 L1 AND COMPLEX
L6 203 COMPLEX (P) OXIDIZER
L7 21 L1 AND L6
L8 2 L7 AND AUTOIGNITION

1. 5,739,460, Apr. 14, 1998, Method of safely initiating combustion of a gas generant composition using an **autoignition** composition; Gregory D. Knowlton, et al., 102/324, 205; 149/45, 109.6; 280/741

2. 5,577,769, Nov. 26, 1996, Hybrid inflator for inflating air bags; Michael Di Giacomo, et al., 280/736, 737, 741

US PAT NO: 5,739,460 L8: 1 of 2
TITLE: Method of safely initiating combustion of a gas generant composition using an **autoignition** composition

ABSTRACT: The present invention relates to an **autoignition** composition for safely initiating combustion of a main pyrotechnic charge in a gas generator or pyrotechnic device exposed to flame or a high temperature environment. The **autoignition** compositions of the invention include a mixture of an **oxidizer** composition and a powdered metal, wherein the **oxidizer** composition includes at least one of an alkali metal or an alkaline earth metal nitrate, a **complex** salt nitrate, such as Ce(NH.sub.4).sub.2 (NO.sub.3).sub.6 or ZrO(NO.sub.3).sub.2, a dried, hydrated nitrate, such as Ca(NO.sub.3).sub.2 .multidot.4H.sub.2 O or Cu(NO.sub.3).sub.2 .multidot.2.5H.sub.2. . . environment. In the method of the invention, the gas generator or pyrotechnic composition is placed in thermal contact with an **autoignition** composition of the invention.

BSUM(18) The most preferred organic **autoignition** compositions include a mixture of silver nitrate, guanidine nitrate, and molybdenum. In such an **autoignition** composition, the amount of molybdenum may be varied to adjust the **autoignition** temperature. If the amount of molybdenum is greater than the stoichiometric amount, the **autoignition** temperature of the **autoignition** composition will decrease as the amount of molybdenum is increased.

L9 19 L7 NOT L8

3. 5,735,118, Apr. 7, 1998, Using metal complex compositions as gas generants; Jerald C. Hinshaw,

5. 5,725,699, Mar. 10, 1998, Metal complexes for use as gas generants; Jerald C. Hinshaw, et al.,
7. 5,673,935, Oct. 7, 1997, Metal complexes for use as gas generants; Jerald C. Hinshaw, et al.,
8. 5,592,812, Jan. 14, 1997, Metal complexes for use as gas generants; Jerald C. Hinshaw, et al.,

11. 5,516,377, May 14, 1996, Gas generating compositions based on salts of 5-nitraminotetrazole; Thomas K. Highsmith, et al., 149/18, 19.1, 36, 62, 92, 109.2

15. 5,472,647, Dec. 5, 1995, Method for preparing anhydrous tetrazole gas generant compositions; Reed J. Blau, et al., 264/3.1; 149/19.92, 109.6; 264/3.4

16. 5,197,758, Mar. 30, 1993, Non-azide gas generant formulation, method, and apparatus; Gary K. Lund, et al., 280/741; 149/61

17. 5,160,386, Nov. 3, 1992, Gas generant formulations containing poly(nitrito) metal complexes as oxidants and method; Gary K. Lund, et al., 149/88, 19.5, 35, 45, 109.4

18. 3,964,255, Jun. 22, 1976, Method of inflating an automobile passenger restraint bag; Vincent Owen Catanzarite, 60/205; 149/75, 77, 109.2; 280/728.1

19. 3,910,805, Oct. 7, 1975, Low temperature gas generating compositions; Vincent Owen Catanzarite, 149/83, 75, 76

US PAT NO: 5,735,118 L9: 3 of 19

ABSTRACT: Gas . . . metal cation template, a neutral ligand containing hydrogen and nitrogen, and sufficient oxidizing anion to balance the charge of the **complex**. The complexes are formulated such that when the **complex** combusts, nitrogen gas and water vapor is produced. Specific examples of such complexes include metal nitrite ammine, metal nitrate ammine, and metal perchlorate ammine complexes, as well as hydrazine complexes. A binder and co-**oxidizer** can be combined with the metal complexes to improve crush strength of the gas generating compositions and to permit efficient. . .

BSUM(19) The . . . a neutral ligand containing hydrogen and nitrogen. One or more oxidizing anions are provided to balance the charge of the **complex**. Examples of typical oxidizing anions which can be used include nitrates, nitrites, chlorates, perchlorates, peroxides, and superoxides. In some cases the oxidizing anion is part of the metal cation coordination **complex**. The complexes are formulated such that when the **complex** combusts, a mixture of gases containing nitrogen gas and water vapor are produced. A binder can be provided to improve the crush strength and other mechanical properties of the gas generant composition. A co-**oxidizer** can also be provided

BSUM(64) It . . . water, and a metal or metal oxide. However, for certain complexes it may be desirable to add a fuel or **oxidizer** to the **complex** in order to assure complete and efficient reaction. Such fuels include, for example, boron, magnesium, aluminum, hydrides of boron or. . .

CLMS(1) What . . . generating substantially non-toxic gas by combusting an at least essentially azide-free gas generating, composition containing at least one metal ammine **complex** having transition metal cation or alkaline earth metal cation and at least one neutral ligand comprised of ammonia, and sufficient. . . one additional ingredient which comprises:
(i) carbon powder,
(ii) a binder, or

(iii) up to about 50% by weight of an inorganic **oxidizer**, such that

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ABSTRACT: Gas . . . metal cation template, a neutral ligand containing hydrogen and nitrogen, and sufficient oxidizing anion to balance the charge of the **complex**. The complexes are formulated such that when the **complex** combusts, nitrogen gas and water vapor is produced. Specific examples of such complexes include metal nitrite ammine, metal nitrate ammine, and metal perchlorate ammine complexes, as well as hydrazine complexes. A binder and co-**oxidizer** can be

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BSUM(64) It . . . water, and a metal or metal oxide. However, for certain complexes it may be desirable to add a fuel or **oxidizer** to the **complex** in order to assure complete and efficient reaction. Such fuels include, for example, boron, magnesium, aluminum, hydrides of boron or. . .

CLMS(14) 14. A gas generating composition formulated from ingredients comprising: at least one **complex** of a metal cation ammonia ligand, and sufficient oxidizing anion to balance the charge of the metal **complex**, wherein said composition contains about 50% to about 80% by weight of said **complex** and said anion; a binder and a co-**oxidizer** such that the binder has a

CLMS(30) 30. A gas generating composition as defined in claim 1, wherein the **complex** is hexaamminecobalt(III) nitrate, ([(NH.sub.3).sub.6 Co](NO.sub.3).sub.3) and the co-**oxidizer** is **copper(II) trihydroxy nitrate (Cu.sub.2 (OH).sub.3 NO.sub.3).**

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BSUM(49) It . . . gas, and a metal or metal oxide. However, for certain complexes it may be desirable to add a fuel or **oxidizer** to the **complex** in order to assure complete and efficient reaction. Such fuels include, for example, **boron, magnesium, aluminum,** hydrides of boron or. . .

CLMS(1) What . . . deploying an air bag or balloon from a supplemental safety restraint system, said gas generating composition comprising at least one **complex** of a transition metal or alkaline earth metal cation, at least one neutral ligand comprising ammonia, and sufficient

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BSUM(24) In . . . tungsten, such as CuO, MnO.sub.2, Co.sub.2 O.sub.3, Co.sub.3 O.sub.4, Fe.sub.2 O.sub.3, MoO.sub.3, Bi.sub.2 MoO.sub.6, Bi.sub.2 O.sub.3, Bi(OH).sub.3, and Cu(OH).sub.2. The **oxidizer** can be an inorganic nitrate or nitrite such as lead nitrate, tin nitrate, NH.sub.4 NO.sub.3, NH.sub.4 NO.sub.2, KClO.sub.4, KNO.sub.3, K.sub.2 Cr.sub.2 O.sub.7, or Sr(NO.sub.3).sub.2. **Complex** metal nitrite and nitrate anions may also be used, of which **Co(NO.sub.2).sub.6, Cu(NO.sub.2).sub.4, and Zn(NO.sub.2)4** are illustrative. The oxidizers can.

US PAT NO: 5,160,386 L9: 17 of 19

ABSTRACT: Gas generating compositions or propellants are provided which comprise a fuel and a novel **oxidizer** therefor comprising an inorganic compound having a **poly(nitrito) transition metal **complex** anion.** The inorganic oxidant compounds are generically represented by the formula:
M.sub.x.sup.1 M.sub.y.sup.2 (NO.sub.2).sub.z wherein (1) M.sup.1 is a metal. . .

BSUM(22) where . . . or 4; y=1 or 2 and z=4 or 6, as determined by the required stoichiometry of the metals of the **complex**, and the M.sup.1 and M.sup.2 metal must not be the same metal. M.sup.1 is preferably an alkali metal, most preferably potassium. Potassium hexanitrocobaltate, K.sub.3 Co(NO.sub.2).sub.6, is the most preferred example of an **oxidizer**.

DETD(2) The . . . relates to solid gas generant or propellant compositions containing as essential ingredients: (1) a gas generating fuel and (2) an **oxidizer** therefor, wherein the **oxidizer** comprises an inorganic compound having a poly(nitrito) transition metal **complex** anion. This **complex** anion may be associated with any stable cation having a valence of up to two chosen

DETD(4) wherein . . . or 4; y=1 or 2; and z=4 or 6 as determined by the required stoichiometry of the metals of the **complex**, and (4) the M.sup.1 and M.sup.2 metals selected are different metals. M.sup.1 is preferably an alkali or alkaline earth metal, most preferably potassium. The most preferred **oxidizer** salt is potassium hexanitrocobaltate, K.sub.3 Co(NO.sub.2).sub.6.

DETD(6) The use of oxidizers (2) having poly(nitrito) transition metal **complex** anions, e.g. K.sub.3 Co(NO.sub.2).sub.6, has been demonstrated with non-azide gas generator fuels, e.g. C.sub.4 H.sub.2 N.sub.3 O.sub.5 K and C.sub.2. . . combustion with a reasonable burning rate as shown in Example 1A and 1B, respectively. The potassium salt of the Co(NO.sub.2).sub.6.sup.-3 **complex** is preferred because it is neither water soluble nor hydroscopic. These properties, i.e. water insoluble and anhydrous, prevent excessive introduction. . . in significantly lower flame temperatures for the

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BSUM(25) As . . . performance of the gas generator system for a passenger restraint bag, involves the non-gaseous products of the reaction between the **oxidizer** compound and the oxygen bearing metal organic compound. The reaction typically produces a metal oxide and when the chlorates or. . . metal salts alone. The binary mixtures of metal oxide and metal chloride, have particularly low melting points and combinations of **oxidizer** and metal organic compound yielding such a mixture upon reaction are preferred. If oxidizers are used that do not yield a metal chloride, it is preferred that different metal ions be present in at least part of the **oxidizer** and metal organic. This assures **at least a binary mixture of metal salts for getting a melting point lower than either metal salt alone. Ternary or more **complex** mixtures of metal salts may be used for low melting.**

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DETD(19) As . . . performance of the gas generator system for a passenger restraint bag, involves the non-gaseous products of the reaction between the **oxidizer** compound and the oxygen bearing metal organic compound. The reaction typically produces a metal oxide and when the

chlorates or. . . . metal salts alone. The binary mixtures of metal oxide and metal chloride, have particularly low melting points and combinations of **oxidizer** and metal organic compound yielding such a mixture upon reaction are preferred. If oxidizers are used that do not yield a metal chloride, it is preferred that different metal ions be present in at least part of the **oxidizer** and metal organic. This assures at least a **binary mixture of metal salts for getting a melting point lower than either metal salt alone. Ternary or more **complex** mixtures of metal salts may be used for low melting.**

L10 1142 HYDRATE# (3A) NITRATE#
L11 6 L1 AND L10

1. 5,739,460, Apr. 14, 1998, Method of safely initiating combustion of a gas generant composition using an autoignition composition; Gregory D. Knowlton, et al., 102/324, 205; 149/45, 109.6;

2. 5,735,118, Apr. 7, 1998, Using metal complex compositions as gas generants; Jerald C. Hinshaw, et al., 60/219; 149/45; 280/741

3. 5,725,699, Mar. 10, 1998, Metal complexes for use as gas generants; Jerald C. Hinshaw, et al., 149/19.1, 45, 75; 280/741

4. 5,656,793, Aug. 12, 1997, Gas generator compositions; Koji Ochi, et al., 149/22, 36, 37, 61, 75, 108.2

5. 5,516,377, May 14, 1996, Gas generating compositions based on salts of 5-nitraminotetrazole; Thomas K. Highsmith, et al., 149/18, 19.1, 36, 62, 92, 109.2

6. 5,429,691, Jul. 4, 1995, Thermite compositions for use as gas generants comprising basic metal carbonates and/or basic metal nitrates; Jerald C. Hinshaw, et al., 149/45, 22, 37; 280/728.1

US PAT NO: 5,735,118 L11: 2 of 6

BSUM(73) The . . . metal carbonate hydroxide oxides, and hydrates and mixtures thereof and a basic metal nitrate such as metal hydroxide nitrates, metal **nitrate** oxides, and **hydrates** and mixtures thereof, including those oxidizers described in U.S. Pat. No. 5,429,691, titled "Thermite

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BSUM(73) The . . . metal carbonate hydroxide oxides, and hydrates and mixtures thereof and a basic metal nitrate such as metal hydroxide nitrates, metal **nitrate** oxides, and **hydrates** and mixtures thereof, including those oxidizers described in U.S. Pat. No. 5,429,691, titled "Thermite

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ABSTRACT: A . . . generator includes a flame coolant containing at least one compound selected from the group consisting of hydrates of metal sulfates, **hydrates** of metal **nitrates**, **hydrates** of metal carbonates, metal hydroxides, and hydrates of metal hydroxides in which

DETD(22) The flame coolant, a compound which causes an endothermic decomposition reaction, is selected from the following group hydrates of metal sulfate: **hydrates** of metal **nitrates**, metal

carbonates, **hydrates** of metal carbonates, metal hydroxide and hydrates of metal hydroxide, in which the metal moieties are selected from the III,. . . V and VI Period metals of the Periodic Table. Of these hydrates, the preferred compounds are hydrates of metal sulfates, **hydrates** of metal **nitrates**, metal carbonates, **hydrates** of metal carbonates, metal hydroxides and hydrates of metal hydroxide, in which the metal moieties are selected from the III. . .

CLMS(4) CLMS(10)

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DETD(10) Zinc nitraminotetrazole was obtained in a manner analogous to Example 2 using, zinc acetate or zinc **nitrate** **hydrate** instead of ZnCl.sub.2.

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DETD(2) The . . . carbonate hydroxides, metal carbonate oxides, and hydrates thereof. As used herein, a basic metal nitrate includes metal nitrate hydroxides, metal **nitrate** oxides, and **hydrates** thereof. The fuel and the oxidizing agent combination is selected with the proviso that substantially nontoxic gaseous reaction products, such. . .

DETD(10) (a) It is a basic metal carbonate, basic metal **nitrate**, or **hydrate** thereof.

DETD(12) Given . . . oxides, metal carbonate hydroxide oxides, and hydrates and mixtures thereof and basic metal nitrates such as metal hydroxide nitrates, metal **nitrate** oxides, and **hydrates** and mixtures thereof wherein the metal species therein can be at least one species

CLMS(15) 15. . . . composition according to claim 1, wherein the oxidizing agent is a basic metal nitrate selected from metal nitrate hydroxides, metal **nitrate** oxides, and **hydrates** and